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(72) Inventor DUNCAN ALEXANDER STIRLING

(19)

(54) IMPROVEMENTS IN OR RELATING TO INSULATION MATERIALS

(71) We, TAC CONSTRUCTION MATERIALS LIMITED., a Company organised under the laws of Great Britain, of 77 Fountain Street, Manchester M2 2EA, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an insulation material for thermal reactors and similar high temperature apparatus.

According to the present invention, there is provided an insulation material consisting of

(a) from 25 to 85% vermiculite granules,
(b) from 5 to 25% asbestos fibres,
(c) from 10 to 50% solid alkali metal silicate,

the percentages of (a), (b) and (c) being by weight of the total weight of (a), (b) and (c),

(d) from 0 to 15% by weight, based on the weight of (c), of fine silica and, optionally,
(e) a water-insoluble silicate formed by reaction of a portion of the alkali metal silicate with an alkaline earth metal compound.

The insulation material may be in the form of a pre-formed lining or moulding for application to an article to be insulated, or may be formed *in situ* as a layer or sheath on a surface of such an article.

Further according to the present invention there is provided a method of manufacturing an insulation material, comprising applying to a surface a forming composition which consists of (i) an aqeous component and (ii) a solid component consisting of

(a) from 25 to 85% vermiculite granules,
(b) from 5 to 25% asbestos fibres,
(c) from 10 to 50% alkali metal silicate,

the percentages of (a), (b) and (c) being by weight of the total weight of (a), (b) and (c),

(d) from 0 to 15% by weight, based on the weight of (c)), of fine silica and, optionally,
(e) an alkaline earth metal compound capable of reacting with a portion of the alkali metal silicate to form a water-insoluble silicate on drying of the forming composition;

and drying the forming composition in contact with the surface. The present invention also provides the forming composition aforesaid.

The surface may be the surface of the article to be insulated, or the surface of a mould (to which a release agent may have been applied), or a surface of a sheet material to form a laminate which is subsequently applied to the article to be insulated. The forming composition may thus be formed into a laminate in which one or both faces of a layer of the material may be bonded to a substrate, such as an asbestos/sodium silicate felt or a batt of mineral fibre, capable of standing temperatures of the order of 900°C. Alternatively, insulation material may be formed on or between sheets of an ignitable or thermally decomposable organic material such as Cellophane (Registered Trade Mark) or cotton scrim cloth which may be destroyed in initial service.

The aqueous component content, which usually will be composed purely of water although it may contain, for example, an acid as described hereafter, can be selected from a wide range depending on several factors including the desired viscosity of the forming composition, the ultimate silicate content of the insulation material and the alkali metal ion concentration. The total solids content of the forming composition will usually be within the range from 35 to 65% by weight of the forming composition, more preferably about 50%.

The forming composition may thus be used as a slurry for casting on a sheet, but more preferably is in the form of a moist granular material or a cohesive mass or dough. The asbestos fibres provide increased strength, both in the moist state and in the dry state.

The handleability of the composition can be increased by adjusting the silicate viscosity by adding up to 15 $^{w}/_{w}$% based on silicate solids of fine silica such as Aerosil 2000 (Registered Trade Mark) or by partially precipitating the hydrated silica from the silicate solution by, for example, the addition of an acid. As an alternative, the forming composition may contain an alkaline earth metal compound such as lime or calcium carbonate to form insoluble silicate on drying to form the insulation material.

The insulation material of the invention and structures formed therefrom are especially suitable for the insulation of thermal reactors or catalytic reactors designed to modify the composition of exhaust gases from internal combustion engines and known as emission control systems. Such reactors operate at temperatures in the range from 800 to 1200°C and require a layer of insulation, in turn usually confined in a metal or other proptective cover, to achieve a surface temperature of up to about 400°C. These temperatures are dictated by the requirements for the efficient operation of the reactor whilst avoiding overheating of the immediate environment, for example other components in the engine compartment of a vehicle. The insulation materials of this invention may also be used to insulate other articles such as chemical reactors and fluid transport pipes, but no real benefit is achieved over conventional materials for these applications except for applications where the operating temperature is in excess of about 700°C.

The materials of the present invention possess many advantages over the mineral fibre materials often used; they are cheap, easily processed, have good temperature resistance (they will readily tolerate 1000°C), have low heat transfer properties, are non-corrosive and non-toxic, and they have a measure of plasticity at high temperatures which gives an improved shock resistance and reduced shakedown.

In order that the invention may be better understood, it will now be described in greater detail in the following example, wherein 'parts' are parts by weight.

Example

A forming composition consists of the following:

600 parts Aqueous Sodium Silicate, 40% solids (Commercial grade)
300 parts Water
300 parts Granular Vermiculite (exfoliated)
50 parts Processed Chysolite Fibre

The asbestos was dispersed in the silicate and water using a Morton Mixer and vermiculite was added to this with slow continuous stirring, to form a dough-like composition, excessive stirring resulting in degradative collapse of the vermiculite being avoided. A weighed mass of the dough was deposited on a sheet of Cellophane and the dough and sheet were passed between spaced rolls set to a desired spacing (say, 0.5 inch) to form a laminate. A second layer of Cellophane was placed on top of the dough layer and the composite laminate so formed was placed in the bottom half of a two-piece mould. The mould was of perforated sheet steel and was provided with spacers to maintain a spacing between the two halves whilst permitting application of a light pressure (eg. 1 atmosphere) to the composite laminate. A moulding was produced by placing the mould and composite laminate in an air circulating oven at a temperature of about 200°C for about 10 minutes to remove excess water from the dough. An insulation material moulding having a thickness of 0.25 inch, made by a method as described above was applied to the outer surface of a steel pipe heated to 1060°C. The temperature at the outside surface of the insulation material was reduced to 385°C.

Many modifications to the above Example will now be apparent, for example, the Cellophane can be replaced by another water-permeable material, or can be omitted, depending on the particular application to which the insulation material is to be put.

WHAT WE CLAIM IS:—

1. An insulation material consisting of
   (a) from 25 to 85% vermiculite granules,
   (b) from 5 to 25% asbestos fibres,
   (c) from 10 to 50% solid alkali metal silicate,

   the percentages of (a), (b) and (c) being by weight of the total weight of (a), (b) and (c),
   (d) from 0 to 15% by weight, based on the weight of (c), of fine silica and, optionally,
   (e) a water-insoluble silicate formed by reaction of a portion of the alkali metal silicate with an alkaline earth metal compound.

2. An insulation material according to Claim 1, in the form of a pre-formed lining or moulding.

3. An insulation material according to Claim 1, in the form of a lining which has been formed *in situ* on a surface of an an article to be insulated.

4. An insulation material according to Claim 2, in the form of a laminate in which

one or both faces of a layer of the material is or are bonded to a substrate.

5. An insulation material according to Claim 4, wherein the substrate is an asbestos/sodium silicate felt or a batt of mineral fibre capable of standing temperatures of about 900°C.

6. An insulation material according to Claim 4, formed on a sheet, or between sheets, of ignitable or thermally decomposable organic material.

7. An insulation material according to Claim 6, wherein the organic material is a water-permeable material.

8. An insulation material according to Claim 1 and substantially as hereinbefore described.

9. An insulation material substantially as hereinbefore described in the Example.

10. A composition for forming an insulation material as defined in Claim 1, which forming composition consists of (i) an aqueous component and (ii) a solids component consisting of

(a) from 25 to 85% vermiculite granules,
(b) from 5 to 25% asbestos fibres,
(c) from 10 to 50% alkali metal silicate.

the percentages of (a), (b) and (c) being by weight of the total weight of (a), (b) and (c),

(d) from 0 to 15% by weight, based on the weight of (c), of fine silica and, optionally,
(e) an alkaline earth metal compound capable of reacting with a portion of the alkali metal silicate to form a water-insoluble silicate on drying of the forming composition.

11. A composition according to Claim 10, having a total solids content within the range from 35 to 65% by weight.

12. A composition according to Claim 10, having a total solids content of about 50% by weight.

13. A composition according to any one of Claims 10 to 12, wherein the silica, if present, has been precipitated from the alkali metal silicate in solution.

14. A composition according to any one of Claims 10 to 13, wherein the aqueous component includes an acid.

15. A forming composition for forming an insulation material, substantially as hereinbefore described.

16. A forming composition substantially as described in the Example.

17. A method of manufacturing an insulation material as claimed in Claim 1, comprising applying to a surface a forming composition according to any one of Claims 10 to 16, and drying the forming composition.

18. A method according to Claim 17, wherein the surface is a surface of an article to be insulated.

19. A method according to Claim 17, wherein the surface is a mould surface.

20. A method according to Claim 17, wherein the surface is a surface of a sheet material which forms a laminate with the composition.

21. A method according to Claim 19, wherein the forming composition is subjected to moulding under a pressure of about 1 atmosphere, and drying of the composition is effected subsequent thereto.

22. A method according to Claim 20, wherein the laminate is subjected to moulding, and drying of the composition is effected subsequent thereto.

23. A method according to Claim 17, of manufacturing an insulation material, substantially as hereinbefore described.

24. A method of manufacturing an insulation material substantially as described in the Example.

25. An insulation material manufactured by a method according to any one of Claims 17 to 24.

B. D. P. WETTERS
Chartered Patent Agent.
Agent for the Applicants.

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